

## METHOD OF IN-SITU REJUVENATION OF ASPHALT PAVEMENT

### FIELD OF THE INVENTION

This invention relates to methods of in-situ rejuvenation of asphalt pavement. More particularly this invention relates to a method of breaking up and rejuvenating an asphalt surface in the region proximate to an obstruction, such as an access cover.

### BACKGROUND OF THE INVENTION

Asphalt pavement consists essentially of an aggregate and sand mixture held together with a petroleum based binder, such as tar. With continued exposure to sun, moisture, traffic, freezing and thawing, asphalt surfaces degrade. The degradation is principally in the binder, rather than the aggregate and sand mixture which makes up the bulk of the asphalt. Also, much of the degradation occurs within the top two or three inches of the surface.

Traditionally, worn asphalt pavement was not restored but instead was torn up and replaced with new asphalt. This is a costly approach and creates a problem as to what to do with the torn up pavement. Accordingly, techniques and apparatus have been developed for restoring or rejuvenating the top few inches of an asphalt paved surface.

A typical road resurfacing apparatus has a heater for heating and softening the asphalt surface as it passes along the asphalt surface. Following the heater is a "rake" or "scarifier" which breaks up or "scarifies" the softened pavement. The scarified pavement is generally crushed or "milled", blended with rejuvenating fluid (and optionally, additional sand or aggregate) and redeposited. The redeposited material is spread out and rolled to create a rejuvenated surface comparable in quality to the original surface before degradation.

Asphalt paved surfaces generally include embedded objects such as access covers and culverts which act as obstructions, and interfere with pick-up of the scarified and/or milled material prior to creation of the rejuvenated surface. The rake generally rides over such objects and does not scarify the proximate area. This necessitated separate treating of the areas around such obstacles

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In yet another aspect, the present invention relates to any of the methods described above, wherein the backhoe apparatus is retractable.

In yet a further aspect, the present invention relates to any of the methods described above, wherein the backhoe apparatus is configured to move vertically relative to the asphalt paved surface.

In another aspect, the present invention relates to the any of the methods described above, wherein the asphalt rejuvenating apparatus further comprises a heater, a raking device, a main mill, and a pug mill, and wherein the heater heats the asphalt paved surface to form the heated asphalt, the raking device dislodges the heated asphalt to form the scarified intermediate, the main mill grinds the scarified intermediate to form the milled intermediate, and the pug mill adds the rejuvenating fluid to the milled intermediate to form the blended intermediate.

In a further aspect, the present invention relates to any of the methods described above, wherein the blended intermediate is dragged to the entrance to the pick-up conveyor by the backhoe apparatus.

The present invention also provides a method of effecting in-situ rejuvenation of an asphalt paved surface with an asphalt rejuvenating apparatus comprising a pick-up conveyor and a backhoe apparatus, wherein the asphalt paved surface includes an obstruction disposed therein, comprising the steps of (a) heating the asphalt paved surface to form heated asphalt, (b) scarifying the heated asphalt to form a scarified intermediate, (c) milling the heated asphalt to form a milled intermediate, wherein a portion of the milled intermediate is deposited proximate to the obstruction, and (d) moving the milled intermediate from proximate the obstruction to the entrance to the pick-up conveyor with the backhoe apparatus.

The present invention also provides a method of effecting in-situ rejuvenation of an asphalt paved surface with an asphalt rejuvenating apparatus including a pick-up conveyor and a backhoe apparatus, wherein the asphalt paved surface includes an obstruction disposed therein, comprising the steps of heating the asphalt paved surface to form heated asphalt, scraping and

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which has traditionally been done using manual techniques (picks and shovels). The use of manual treating is generally slow and often doesn't promote adequate depth of scarification.

It is an object of the present invention to provide a method using a mechanized apparatus for facilitating removal of scarified and/or milled asphalt material from around obstructions in the road surface.

### SUMMARY OF THE INVENTION

The present invention provides a method of effecting in-situ rejuvenation of an asphalt paved surface with an asphalt rejuvenating apparatus comprising a pick-up conveyor and a backhoe apparatus, wherein the asphalt paved surface includes an obstruction disposed therein, comprising the steps of (a) heating the asphalt paved surface to form heated asphalt, (b) scarifying the heated asphalt to form a scarified intermediate, (c) milling the scarified intermediate to form a milled intermediate, (d) adding rejuvenating fluid to the milled intermediate to form a blended intermediate, wherein the blended intermediate is deposited proximate the obstruction, and (e) moving the blended intermediate from proximate the obstruction to the entrance to the pick-up conveyor with the backhoe apparatus.

In one aspect, the present invention relates to the method described above, wherein, during Step (d), the blended intermediate is deposited behind the obstruction relative to the entrance to the pick-up conveyor.

In a further aspect, the present invention relates to any of the methods described above, wherein the backhoe apparatus moves laterally relative to the asphalt paved surface connecting the blended intermediate to the entrance to the pick-up conveyor.

In a further aspect, the present invention relates to any of the methods described above, wherein the backhoe apparatus is rotatably mounted to the asphalt rejuvenating apparatus for rotation about an axis perpendicular to the asphalt surface. In one embodiment, the backhoe apparatus is rotatably mounted to the pick-up conveyor.

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pulling the heated asphalt proximate to the obstruction with the backhoe apparatus to form a first intermediate, and moving the first intermediate from proximate the obstruction to an entrance to the pick-up conveyor with the backhoe apparatus.

### **DESCRIPTION OF THE DRAWINGS**

5 The embodiments of the present invention are described below with reference to the accompanying drawings in which:

Figure 1 is an illustration of an asphalt rejuvenating apparatus for carrying out the method of the present invention;

Figures 2 to 7 are side elevation views of the backhoe apparatus and pick-up conveyor of the asphalt rejuvenating apparatus in Figure 1, in various positions of orientation; and

Figures 8 to 10 are top plan views of the backhoe apparatus and pick-up conveyor of the asphalt rejuvenating apparatus of Figure 1, illustrating obstructions in the road surface disposed in different positions relative to the entrance to the pick-up conveyor, and further illustrating the movement of the backhoe apparatus in carrying heated, raked, and milled asphalt from around the obstructions and towards the entrance to the pick-up conveyor.

### **DETAILED DESCRIPTION**

A typical asphalt rejuvenating apparatus is generally indicated by reference numeral 10 in Figure 1. The rejuvenating apparatus 10 travels in a path of travel indicated by arrow 12 upon asphalt surface 18. An obstruction 19, such as an access cover, culvert pipe, manhole, or utility structure is disposed within the asphalt surface 18.

A power plant 14 at the front is provided to drive the apparatus and typically includes an engine and a hydraulic system. Behind the power plant 14 is a heater box 16 which includes numerous burners and associated plumbing for heating the asphalt surface 18. A propane (or other combustible fuel) tank 20 and a combustion blower 22 would typically be provided. The heater

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box 16 directs heat at the asphalt surface 18 to cause softening of an upper part of the asphalt surface 18.

The softened asphalt surface 18 is initially dislodged by a raking device, generally indicated by reference 100 which follows the heater box 16. The raking device 100 is described in more detail below, after a brief overview of the overall layout and operation of the asphalt rejuvenating apparatus 10. The rakes 100 dislodge the heated asphalt surface 18. The rakes 100 may include main rakes 102 and extension rakes 104, the extension rakes 104 performing a similar function to the main rakes 102, but to the outside edges. The main rakes 102 break up material around manholes where a main mill 36 behind the rakes 100 cannot run.

The main mill 36 grinds up the material dislodged by the rakes, levels the underlying surface and prepares the surface to a preset depth. Extension mills 38 ahead of the main mill 36 perform a similar function, but process outer material typically from 10 to 15 feet to each side of the rejuvenating apparatus 10 and move it to a central part of the rejuvenating apparatus 10 where it is subsequently processed by the main mill 36.

A pug mill 40 follows the main mill 36 and mixes the processed material from the main mill 36 with rejuvenating fluid from a tank 42. Blended material 46 from the pug mill 40 is picked up by a pick-up conveyor 44 through its entrance 45. The pickup conveyor 44 deposits the blended material 46 in a heated holding hopper 48. The holding hopper 48 keeps the blended material 46 hot until it is needed. The holding hopper 48 may be filled through its top with material for start ups or if additional material is needed. The holding hopper 48 may also be dumped if required or at the end of a day's operation.

A screed 50 follows the asphalt rejuvenating apparatus 10 and may be a unit such as typically found on an asphalt paver. The screed 50 lays, spreads and slightly compacts the blended material 46 for final rolling.

A water system 52 may be provided to supply cooling water to front and rear tires or tracks 54.

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An operator 56 operates a control and processing station 58. The operator 56 can input and monitor the amounts of rejuvenating fluid, sand and aggregate being added, as well as control operation of a backhoe apparatus 200, to be described in further detail below.

A sand/aggregate bin 60 precedes the asphalt rejuvenating apparatus 10. The sand/aggregate bin 60 may be attached to the asphalt rejuvenating apparatus 10 or attached to a separate machine (not shown) running in front thereof. Sand/aggregate is metered at a specific rate which is a function of ground speed and specification requirements.

The rejuvenating apparatus 10 is provided with the backhoe apparatus 200 to facilitate rejuvenating of asphalt surface 18 in a region proximate to, or in the vicinity of, the obstruction 19. The backhoe apparatus 200 is configured for lateral movement relative to the asphalt surface 18 connecting the blended material 46 and the entrance 45 to pick-up conveyor 44. Further, backhoe apparatus 200 is configured for vertical movement, relative to the plane defined by the asphalt surface 18, as well as retractable movement in the general direction from the blended material 46 and to the entrance 45 of the pick-up conveyor 44.

The backhoe apparatus 200 is rotatably mounted to a frame 202 of the rejuvenating apparatus 10. In one embodiment, and as illustrated in Figure 1, the pick-up conveyor 44 includes the frame 202. In this respect, the backhoe apparatus 200 is, therefore, rotatably mounted to pick-up the conveyor 44. Rejuvenating apparatus 10 includes hydraulic motors (not shown) to effect rotation of the backhoe apparatus 200 relative to the pick-up conveyor 44.

Referring to Figures 2 to 7, the backhoe apparatus 200 includes a boom 204, an arm 206, and a blade 208. The boom 204 has one end pivotally connected at 210 to the frame 202, and the other end pivotally connected at 212 to one end of the arm 206. The other end of the arm 206 is pivotally connected at 214 to a base end of the blade 208. The blade 208 has a scraping end 216 away from the base end.

A double-acting linear actuator 2181, such as a fluid pressure actuated cylinder, is operatively connected between the frame 202 and the boom 204 for controlling the pivotal movement of the

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boom 204 about the pivot point 210. Similarly, another double-acting linear actuator 2182 is operatively connected between the boom 204 and the arm 206 for controlling the pivotal movement of the arm 206 about the pivot point 212. A further double-acting linear actuator 2183 is operatively connected between the arm 206 and the blade 208 for controlling the pivotal movement of the blade 208 about the pivot point 214.

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Figures 2 to 7 illustrate the backhoe apparatus 200 of the present invention in various orientations. Figure 2 illustrates backhoe apparatus wherein the boom 204 is fully raised, the arm 206 is fully extended and the blade 208 is disposed in a fully retracted position. Figure 3 is similar to Figure 2, with the exception that the blade 208 is disposed in the fully-retracted position. Figure 4 illustrates the backhoe apparatus in a different orientation, wherein the boom 202 is fully raised, and the arm 206 is disposed in the fully tucked position. Figure 5 illustrates the backhoe apparatus with the boom 204 lowered to effect contact of the blade 208 with the asphalt paved surface 18, and with the arm 206 and the blade 208 fully extended. In this orientation, the blade 208 makes contact with the processed asphalt surface 18, which has been previously subjected to preheating, raking, and milling. Figure 6 illustrates the backhoe apparatus 200 with the boom 204 lowered, and with the arm in the tucked position, and the blade 208 in a fully extended position to reach an edge of the obstruction 19. Figure 7 illustrates the backhoe apparatus 200 with the boom 204 lowered, and with the arm 206 in the tucked position, and with the blade 208 in the retracted position.

In one embodiment, backhoe apparatus 200 is BRADCO™ Model No. 6L9.

After heating, raking and milling of asphalt surface 18 by the rejuvenating apparatus 10, material may collect in the region proximate to, or in the vicinity of, the obstruction 19. The obstruction 19 obstructs the pick-up conveyor 44, and makes it difficult for the pick-up conveyor 44 to collect material from around the obstruction 19. Similarly, even where the asphalt surface 18 is only heated by the rejuvenating apparatus 10, it is difficult to break up and pull away the heated asphalt surface 18 from around the obstruction. The backhoe apparatus 200 facilitates removal of such material from around the obstruction 19 and its movement to the entrance 45 of the pick-up conveyor 44.

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In this respect, the present invention provides a method of effecting in-situ rejuvenation of an asphalt paved surface with an asphalt rejuvenating apparatus including a pick-up conveyor 44 and a backhoe apparatus 200, wherein the asphalt paved surface includes a solid object disposed therein ahead of the pick-up conveyor 44, comprising the steps of: (i) heating the asphalt paved surface 18 to form heated asphalt, (ii) scarifying the heated asphalt to form a scarified intermediate, (iii) milling the scarified asphalt to form a milled intermediate, (iv) adding rejuvenating fluid to the milled intermediate to form a blended intermediate 46, wherein the blended intermediate is deposited proximate the obstruction, and (v) moving the blended intermediate 46, from around and proximate to, or in the vicinity of, the obstruction 19 and to the entrance 45 to the pick-up conveyor 44 with the backhoe apparatus 200.

In one embodiment, the asphalt rejuvenating apparatus comprises a heater box 16, a raking device 100, a main mill 36, and a pug mill 40. The heater box 16 heats the asphalt paved surface 18 to form the heated asphalt. The raking device 100 scarifies the heated asphalt to form a scarified intermediate. The main mill 36 grinds the scarified intermediate to form a milled intermediate. The pug mill 40 adds rejuvenating fluid to the milled intermediate and mixes the milled intermediate with the rejuvenated fluid to form a blended intermediate 46. The blended intermediate 46 is then carried or dragged by the backhoe apparatus 200 to the entrance 45 of the pick-up conveyor 44.

The backhoe apparatus 200 is useful in carrying or dragging blended intermediate 46 from behind an obstruction 19, where the obstruction 19 is disposed between the blended intermediate 46 and the pick-up conveyor 44. In one embodiment, the blended material is deposited behind the obstruction relative to the entrance 45 to the pick-up conveyor 44. The backhoe apparatus is configured to move laterally relative to the asphalt surface connecting the blended intermediate 46 to the entrance 45 to the pick-up conveyor 44. In this respect, the backhoe apparatus 200 is rotatably mounted to the asphalt rejuvenating apparatus 10 about an axis perpendicular to the asphalt paved surface 18. The backhoe apparatus 200 is rotatably mounted to the pick-up conveyor 44. To further assist in transportation of the blended intermediate 46, the backhoe apparatus 200 is configured to be retractable as well as capable of moving vertically relative to the asphalt paved surface 18.



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Figures 8 to 10 illustrate the path along which the blended material 46 is moved by the backhoe apparatus 200 from around or behind an obstruction 19. Each of the figures illustrate the obstruction 19 disposed in different positions relative to the entrance 45 of the pick-up conveyor 44. Figure 8 illustrates a path along which the blended material 46 is carried by backhoe apparatus 200 by way of directional arrows 220a, 220b, 220c and 220d. In this illustration, the obstruction 19 is disposed directly along a centre line 230 of the entrance 45 to the pick-up conveyor 44. Figure 9 illustrates the possible paths along which blended intermediate 46 may be carried by backhoe apparatus 200, when the obstruction 19 is disposed to one side of the centre line 230 of entrance 45 to pick-up conveyor 44, by way of directional arrows 222a, 222b, and 222c. Figure 10 illustrates paths along which blended intermediate 46 may be carried by backhoe apparatus 200 when the obstruction 19 is located along the other side of centre line 230 of entrance 45 to pick-up conveyor 44, by way of a directional arrow 224a, 224b, and 224c.

In another embodiment, there is provided a method of effecting in-situ rejuvenation of the asphalt paved surface 18 with the asphalt rejuvenating apparatus including the pick-up conveyor 44 and a backhoe apparatus 200, wherein the asphalt paved surface 18 includes the obstruction 19 disposed therein, comprising the steps of: (i) heating the asphalt paved surface 18 to form heated asphalt, (ii) scarifying the heated asphalt to form a scarified intermediate, (iii) milling the scarified asphalt to form a milled intermediate, and (iv) moving the milled intermediate 46 to an entrance 45 to the pick-up conveyor 44 with the backhoe apparatus 200. Rejuvenating fluid may be added prior to milling of the asphalt paved surface 18.

In another embodiment, backhoe apparatus 200 is used to scrape and pull the heated asphalt in the region proximate to, or in the vicinity of, the obstruction 19. In this respect, there is also provided a method of effecting in-situ rejuvenation of an asphalt paved surface 18 with an asphalt rejuvenating apparatus including the pick-up conveyor 44, and the backhoe apparatus 200, comprising the steps of: (i) heating the asphalt paved surface 18 to form heated asphalt, (ii) scraping and pulling the heated asphalt proximate to, or in the vicinity of, the obstruction with the backhoe apparatus 200, to form a first intermediate, (iii) moving the first intermediate to the entrance 45 to the pick-up conveyor with the backhoe apparatus 200.

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Although the disclosure describes and illustrates various embodiments of the invention, it is to be understood that the invention is not limited to these particular embodiments. Variations and modifications may occur to those skilled in the relevant art. For definition of the invention, reference is to be made to the appended claims.

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